Intelligent Healthcare Systems

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Dr. Vania V. Estrela

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Preface

Information is paramount to the healthcare sector, entailing intense data, medical epidemiologic sets, Internet browsing records, surveys, complex engineering models, and so on via the Cloud. This quest for knowledge prompts data dimensionality, which calls for more sophisticated and efficient information strategies. Health science and biology are very complex fields fully embedded in information technology, but the associated processes are much too intricate to be faithfully modeled. It is not easy to extract knowledge starting from raw data, and it is also expensive.

Artificial intelligence (AI) in healthcare (AIH) has been the primary concern to develop expert systems aimed at diagnostic and decision-making in knowledge acquisition, representation, reasoning, and explanation. Many healthcare facilities (HFs) have data acquisition, monitoring, and storage systems integrated into larger-scale information systems. This vast amount of information and databases stemming from medical applications cause hindrances to analysis and decision making. Hence, there is a need to develop better tools for accessing/storing/analyzing knowledge while effectively using multimodal data. These necessities become essential in the healthcare realm as decision-making relies on knowledge from multidisciplinary areas. This book intends to provide computational methods for intelligent health data analysis to narrow the gap between data gathering and data comprehension with applications in medicine, health care, biology, pharmacology, and related areas. Intelligent Data Analysis (IDA) expedites healthcare analyses and applications. IDA employs specialized statistical, pattern recognition, machine learning (ML), data abstraction, and visualization tools for the analysis of data and discovery of mechanisms that created them. Healthcare data typically involve many records/variables, subtle interactions between entities, or a combination of all factors. Engineering, computing science, and ML empower data analysis tasks. The IDA extracts knowledge from vast data, with a huge quantity of variables, data that represents very complex, nonlinear, real-life problems. IDA can help with raw data analysis, coping with prediction tasks without knowing the theoretical description of the underlying process, classification tasks of new events, or modeling unknown processes. Classification, prediction, and modeling are the cornerstones brought in by IDA. This book focuses on AIH methods and tools to bridge data gathering and data comprehension. Emphasis will also be given to problem-solving within HFs to handle patient records, data warehousing, intelligent alarming, competent monitoring, and more. In medicine, overcoming this gap is particularly crucial since

medical decision-making needs comprehension of healthcare data regularities and trends. This book tackles different IDA approaches.

This book has three parts and a total of 18 chapters as follows:

1. Introduction to Intelligent Healthcare in a Post-Pandemic World
2. The Building Blocks of Health 4.0 – Internet of Things, Big Data with Cloud and Fog Computing
3. Internet of Medical Things (IoMT) Layers for Medical Cyber-Physical Systems
4. Ad Hoc Networks in Healthcare Intelligent Transportation Systems – MANETs, VANETs, and FANETs
5. Scale and Resolution Issues regarding Medical Images: Challenges Ahead
6. Some Issues regarding Content-Based Image Retrieval (CBIR) for Remote Healthcare Thera diagnosis
7. Blockchain Technology Enabling Better Services in the Healthcare Domain
8. 6G in Healthcare – Anticipating Needs and Requirements
9. Remote Sensing Applications in Disease Mapping and Public Health Analysis
10. On DICOM, HEVC and 3D Medical Image Compression for Volumetric Theragnostics
11. Deep Learning as a Drive Force for Better Drug Development
12. In-Body Devices and Sensors Communication - How Implantables, Ingestibles, and Injectables Interact with the Internet
13. Nanotechnology, Internet of Nano things and Nanorobotics in Healthcare – Nano for All
14. Digital Twin Framework for Intelligent Healthcare Facilities through ISO/IEEE 11073
15. Medical Visual Theragnostic Systems Using Artificial Intelligence (AI) - Principles and Perspectives
16. Metaheuristics Applied to Pathology Image Analysis
17. Super-resolution Image Processing for Hemoglobin Quantification: A Case Study
18. BrATCat: Data Augmentation of MRI Scans via Image-to-Image Translation using CycleGAN Followed by Pre-Trained Model Categorization

Prospective readers will experience several facets of intelligence in terms of AI and assorted smart designs besides observing the target subjects' evolving nature. This book offers different alternatives and methods to expand existing implementations with effective results in several realms, for instance, graduate course classrooms, research facilities, healthcare services, non-destructive investigations, ambient intelligence, medical education, and healthcare facilities' plants. This book also made it possible to gather an interesting group of invited international authors, who put forward a different understanding within their respective chosen research fields with experimental outcomes.

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Contents

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Part I

Intelligence Meanings and Roles in Healthcare: Introductory Aspects

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